

# **Influencing Future Exploratory Drilling Rates—A Potential Approach for the Waste Isolation Pilot Plant - 15307**

Abraham Van Luik\*, Russell Patterson\* and G. Ross Kirkes\*\*

\*Department of Energy-Carlsbad Field Office, 4021 National Parks Highway, Carlsbad, NM 88220, [Abraham.VanLuik@cbfo.doe.gov](mailto:Abraham.VanLuik@cbfo.doe.gov)

\*\*Piru Associates, Inc., 602 Harkness Rd, Carlsbad, NM 88220

## **ABSTRACT**

The Department of Energy/Carlsbad Field Office (DOE/CBFO) is responsible for managing activities related to the disposal of TRU and TRU-mixed waste in the geologic repository at the Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico. The WIPP Compliance Certification Application had a reference concerning natural resources at the site of the Waste Isolation Pilot Plant. This reference suggested that resources could be withdrawn from under the repository area from a distance and not affect the integrity of the repository. This would not eliminate, but would certainly diminish, the rate of exploratory drilling in the distant future. Currently the only scenarios that result in releases from the repository are human intrusion scenarios, without human intrusion radioactive releases to the accessible environment are essentially zero for the very long term future.

## **INTRODUCTION**

The Department of Energy/Carlsbad Field Office (DOE/CBFO) is responsible for managing the geologic repository at the Waste Isolation Pilot Plant (WIPP), near Carlsbad, New Mexico. The WIPP Compliance Certification Application [1] had as a supporting reference a document entitled: “*Natural Resources Study, Waste Isolation Pilot Plant (WIPP) Project, Southeastern, New Mexico*” [2] which stated its purpose in the following words:

“The study is specifically aimed at the potential consequences of developing the resources in Control Zone IV, and using directional drilling from within Zone IV to recover the hydrocarbons underlying Zones I, II, and III. Nearly 75 percent of the attractive potash deposits underlie this outer buffer zone and all of the natural gas and distillate reserves can be accessed by existing drilling techniques (either vertical or directional) from within Control Zone IV” . . . . “Accordingly, allowing resource recovery from within Zone IV substantially mitigates any adverse economic and social impacts of permanent resource denial.”

The concern was resource denial, a short- to medium-term issue. But there is also a longer-term issue as recognized in the Code of Federal Regulations (CFR) Part 194 [3], Paragraph 43(c), which states that credit for passive institutional controls may be taken for reducing the human intrusion likelihood, but that credit . . . “cannot be used for more than several hundred years and

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may decrease over time. In no case, however, shall passive institutional controls be assumed to eliminate the likelihood of human intrusion entirely.”

The reduction of the WIPP underground’s attractiveness to exploratory drillers seeking oil and gas resources is not addressing a regulatory compliance need. It would be done to “improve the robustness of the safety case for disposal,” an optimization activity. The International Atomic Energy Agency’s HIDRA (Human Intrusion in the context of Disposal of Radioactive Waste) project’s presentation at the Waste Management 2014 Symposium stated that [4]:

HI is not addressed in the context of a dose constraint, it is considered in the context of optimization to improve the robustness of the safety case for disposal. The optimization of the disposal system refers in principle to the need to take measures to:

Reduce the possibilities or likelihood of HI, and

Reduce the consequences of HI (i.e. radiological impacts and impacts to safety functions).

Diminishing the resource-attractiveness of the deep underground at WIPP would certainly reduce the likelihood of HI. Such an optimization activity is not addressing a regulatory requirement. It is optimizing long-term safety.

## **STATUS**

When the applicable regulation [3] decreased credit for the effectiveness of passive institutional controls with time, it also invited DOE to make case for their effectiveness in its paragraph 43(b): . . . “Any compliance application shall include the period of time passive institutional controls are expected to endure and be understood within the first thousand years after closure.” That was not done by the DOE. No credit for passive institutional control effectiveness was taken beyond the monitoring period of 100 years because it was not necessary to do so to show compliance with the long-term safety standards. The system is robust.

Consequently every long-term performance evaluation has several assumed drill-hole intrusions into the repository [5] (an average of 8 such intrusions in the 10,000 year regulatory period of interest). The salt host rock is protective, allowing no water to flow through it. These exploratory or producing boreholes, however, can provide pathways to overlying saturated units if the required concrete borehole plugs degrade or fail.

The 100-year averaged rate of drilling in the Permian Basin is used in the formula prescribed by regulation to estimate borehole intrusion frequencies into the future. Figure 1 shows the well pads in place in the portion of the Permian Basin near the WIPP Land Withdrawal.

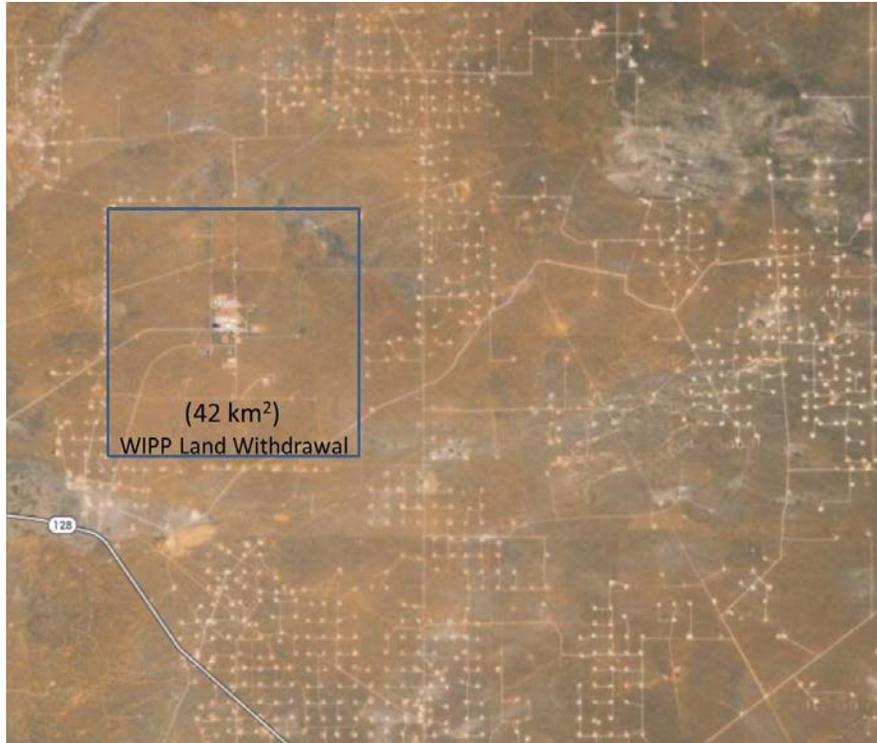


Figure 1. Well Pads in the Portion of the Permian Basin near the WIPP Site

The Land Withdrawal Act boundary is again outlined in a closer-in photo in Figure 2 and shows it surrounded on several sides by well pads. This suggests the site is likely to be of commercial development interest. An industry report cited in a report by the Environmental Evaluation Group suggests there is substantial oil and gas beneath the WIPP site [6].

The pre-emptive drilling program discussed in this paper would serve to remove the fossil fuels of interest beneath the salt beds within the Land Withdrawal Area. Doing this would not make the long-term safety evaluation for WIPP more compliant than it currently is. The repository readily complies with the existing 10,000 year performance requirements. However, it is a way to optimize and enhance longer term safety by reducing the likelihood/frequency of future human intrusions, and could become important if in the future there is a regulatory change applicable to the WIPP repository.

## DISCUSSION

In its evaluation of the initial Compliance Certification Application, the Environmental Protection Agency noted in its response that the frequency of human intrusion (drillholes through the repository area) was properly evaluated by the DOE in accordance with requirement 33.D.1 [7] (excerpts cited below):



Figure 2. WIPP facilities location within the Land Withdrawal Area

### 33.D.1 REQUIREMENT

(b) “The following assumptions and process shall be used in assessing the likelihood and consequences of drilling events, and the results of such process shall be documented in any compliance application:

(3) The frequency of deep drilling shall be calculated in the following manner:

(i) Identify deep drilling that has occurred for each resource in the Delaware Basin over the past 100 years prior to the time at which a compliance application is prepared.

(ii) The total rate of deep drilling shall be the sum of the rates of deep drilling for each resource.”

This formula yielded the following borehole intrusion frequencies, as calculated by the DOE [7]:

. . . The number and time of intrusions were represented using a Poisson process to calculate the time period that elapsed between intrusions, based on historical drilling activity and assuming a rate of 46.8 boreholes per square kilometer. . . .

. . . The potential time between intrusions varied from 0 to 9,900 years. Using this process, DOE concluded that the most likely number of intrusions into a waste panel is 5, occurring with a probability of 0.1715. Zero intrusions occurred with a probability of 0.0041. DOE indicated that the largest number of intrusions that can occur is 14, with a probability of 0.0011. . .

As drilling continues in the Permian Basin, this calculated borehole frequency increases with time. By the time of the 2014 Compliance Recertification Application, this 46.8 boreholes/ km<sup>2</sup> rate had risen to 67.3 boreholes/ km<sup>2</sup> [8]:

The method for determining the deep drilling rate for the WIPP PA has not changed for the CRA-2014. However, the drilling rate for the CRA-2014 has been updated. Derivation of the drilling rate used in PA is found in the Delaware Basin Monitoring Report for 2012 . . . . For the CRA-2014, the drilling rate is 67.3 boreholes/km<sup>2</sup>, an increase from the previous value of 59.8 boreholes/km<sup>2</sup> for the CRA-2009 PABC. Therefore, the DOE continues to comply with section 194.33(b)(3).

As the drill rate per square kilometer increases, so do the frequencies of boreholes intersecting the repository, but the net result is a continuing large margin in terms of demonstrating regulatory compliance for the 10,000 year period defined by the applicable regulation (see Figure 3).

So the reason for drilling for oil and gas removal from underneath the current repository and potential future repository areas has nothing to do with regulatory compliance; instead, it is a practical way of assuring additional far-future safety beyond regulatory compliance: optimizing long term safety.

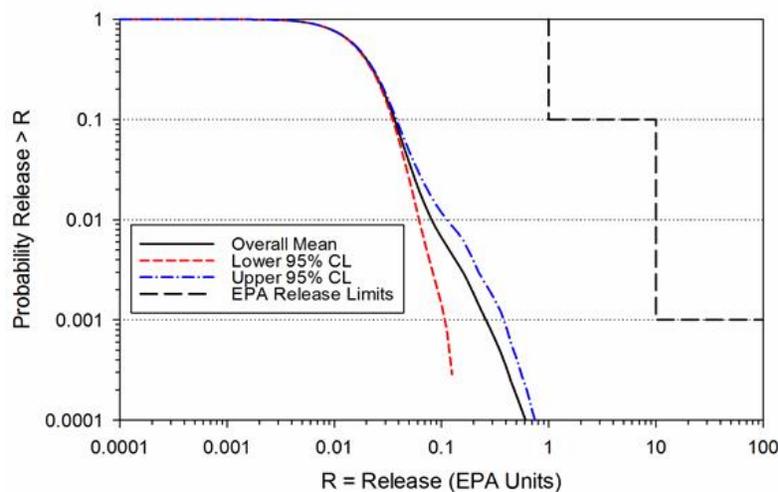


Figure 3. Mean and Confidence Interval CCDFs for Total Normalized Releases: CRA-2014 PA (from Figure 34-6 in [9])

**PRECEDENT**

There is precedent for this proposal made back in 1982. There was then and continues to be limited drilling underneath one section of the Land Withdrawal Area, coming in below the 6,000 foot depth to which the Land Withdrawal Act applies [10]:

SCR-5.1.1.1.3 Historical, Current, and Near-Future Human EPs

. . . Oil leases that pre-existed the withdrawal of land by the Federal government for the WIPP in Section 31 were not condemned, as it was determined that production of these resources could be conducted without adverse effects to the WIPP. As such, the DOE only controls from the surface to 6,000 ft (1,829 m) below ground surface. Operators have continued to produce these leases and four new horizontal wells have been drilled beneath this section since the last recertification application. This continued development and production is consistent with the expectations of the DOE and the EPA . . . These wells originate outside the WIPP boundary and transition to horizontal orientation at depths below 6,000 ft (1,829 m). The vertical portion of these drill holes lie outside the WIPP boundary. Therefore, it is not expected that vertical wells will be initiated within the WIPP site during the HCN time frame. This assumption is based on current federal ownership and management of the WIPP during operations, and assumed effectiveness of institutional controls for the 100-yr period immediately following site closure.

Note that this type of resource withdrawal well below 6,000 feet was determined to have no adverse effects on the repository [11]. A map of the current deviated wells and their bottom-hole locations that extract resources from beneath Section 31 of the WIPP site, at the present time, is shown in Figure 4.

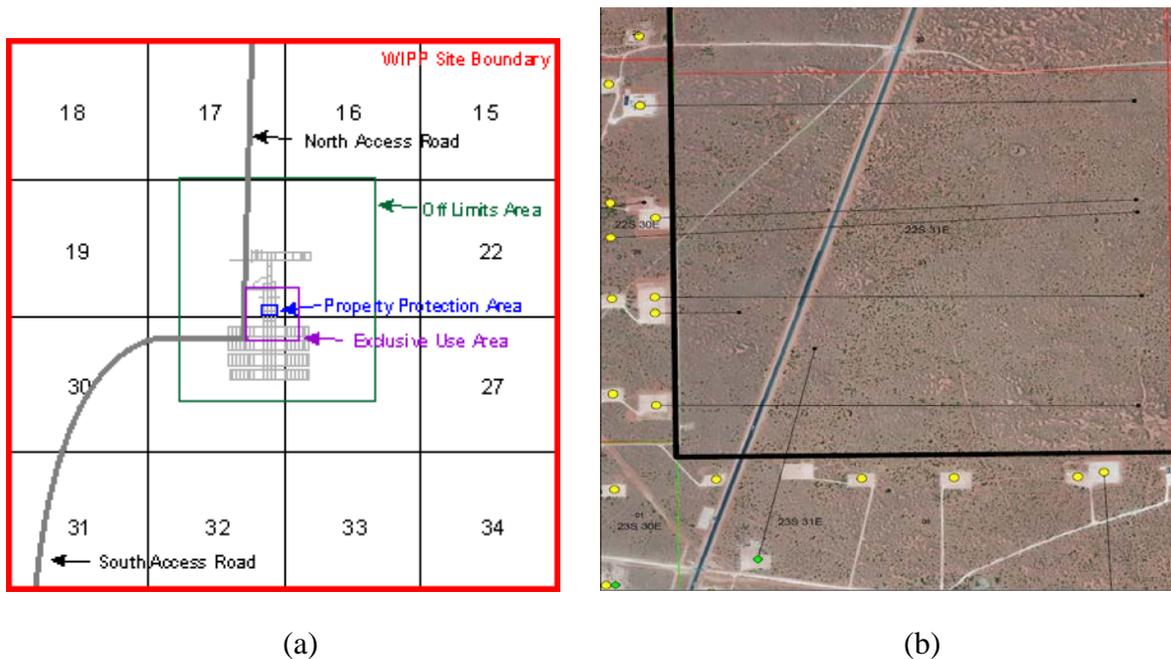


Figure 4: (a) Sections within the WIPP Site and (b) Deviated wells beneath Section 31

## CONCLUSION

As proposed in 1982 [2] and included in the original Compliance Certification Application [1], controlled vertical drilling from areas away from the repository yet within the Land Withdrawal to extract resources from under the repository, and perhaps from under other portions of the Land Withdrawal, can lower the risk of future human intrusions into the repository.

There is precedent in that existing oil and gas extraction from the Land Withdrawal Area at the time of the passage of the Land Withdrawal Act was allowed to continue since this extraction activity took place below 6,000 feet and would have no impact on the repository. Planning for this type of extraction activity, in a controlled manner, can:

Assure that borehole frequencies do not continue to rise in the long-term. This, in turn would assure a lowering of the human intrusion risk in a real sense since a future borehole that shows a meager return on investment becomes an effective marker for an extended period of time.

This is not a statement of a US Department of Energy preferred option, it is a further exploration of an idea previously proposed in 1982 and included by reference in the Compliance Certification Application of 1996. A number of issues would need to be resolved in order to implement this 1982 proposal, as reiterated here. These issues are not addressed in this paper.

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